

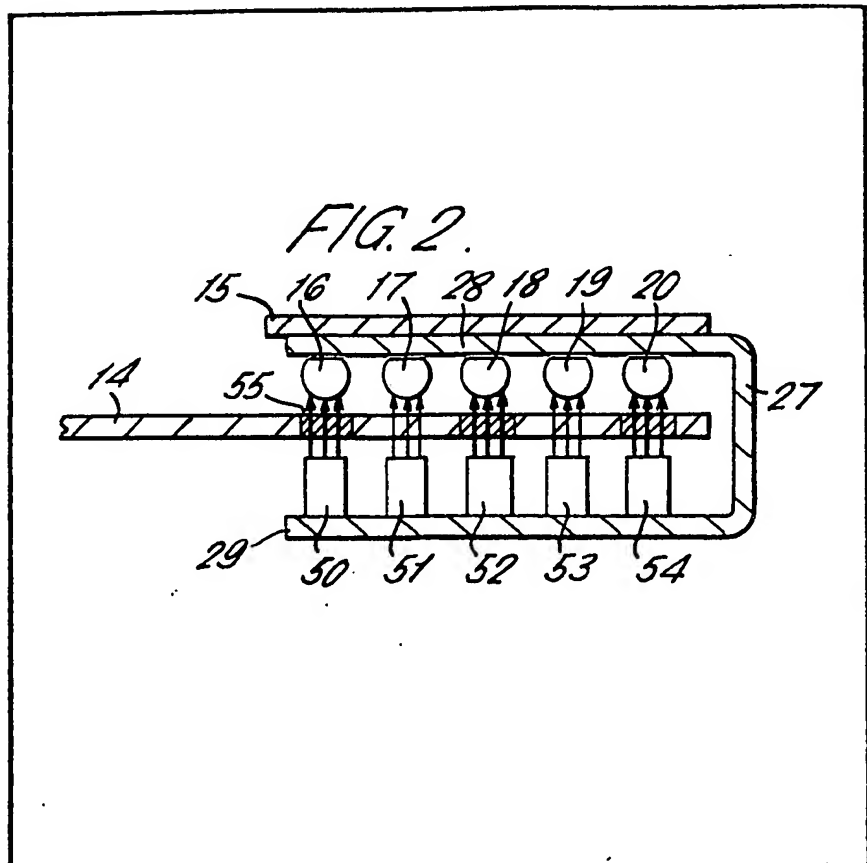
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(54) Apparatus for Detecting the Angular Positioning of a Fruit Machine Reel

(57) Apparatus for detecting the angular position of a fruit machine reel, has magnets 50—54 and Hall devices 16—20 arranged in pairs and fixed. A coding disc 14 rotates with the reel 10 and has code elements 21

which pass between the various magnet and Hall device pairs. The elements 21 are either metal slugs 55 in a dielectric disc or apertures 56 in a metal disc and shunt magnetic field to effect coded switching of the Hall devices. A ferro-magnetic U-shaped bracket 27 provides a return path for the magnets enhancing field strength at the Hall devices.



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FIG. 1.

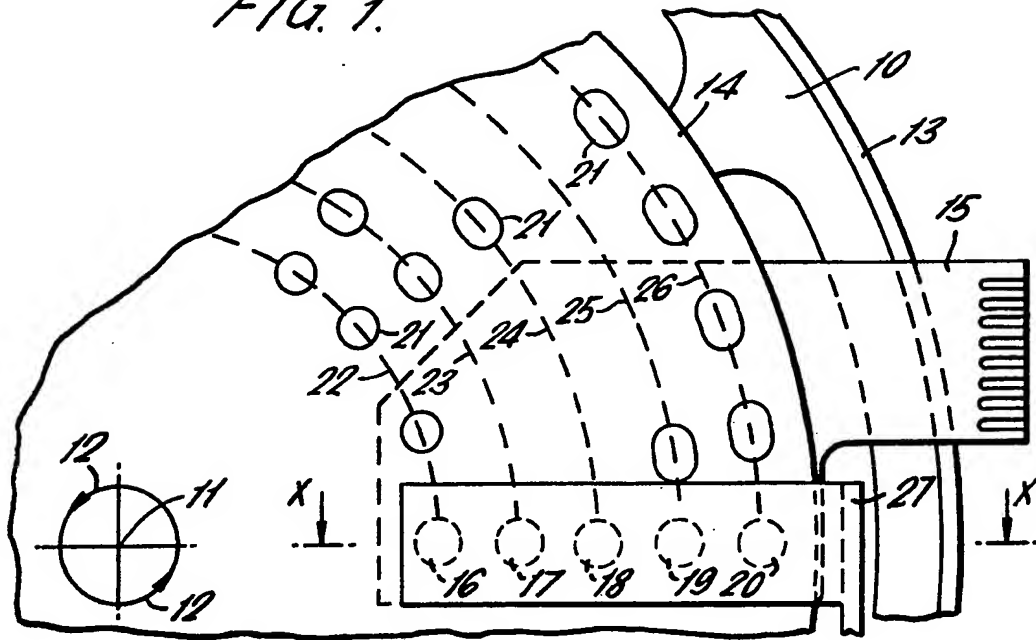


FIG. 2.

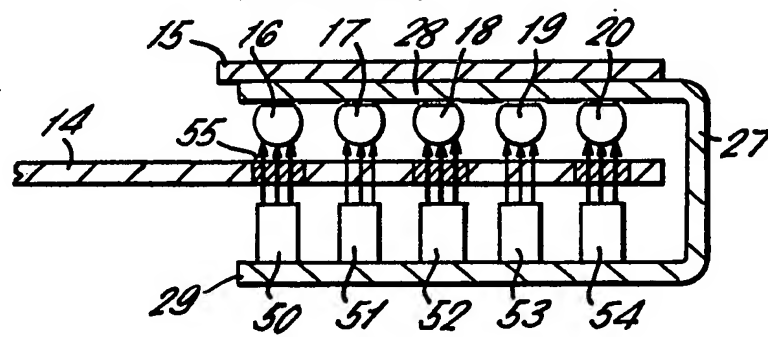
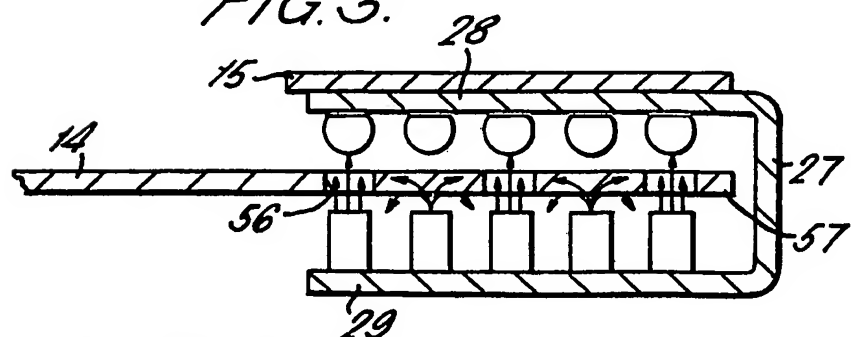


FIG. 3.



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FIG. 4.

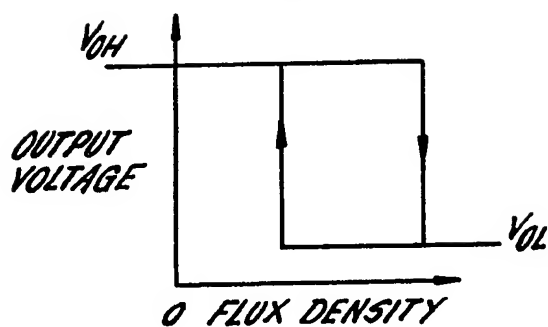


FIG. 5.

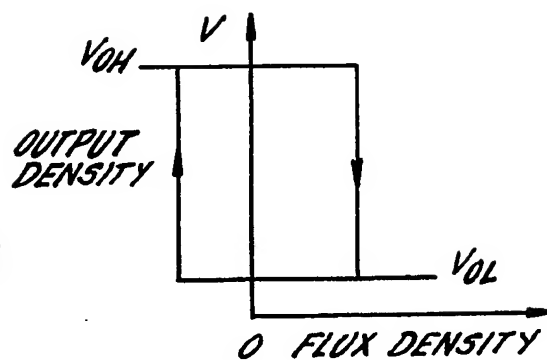
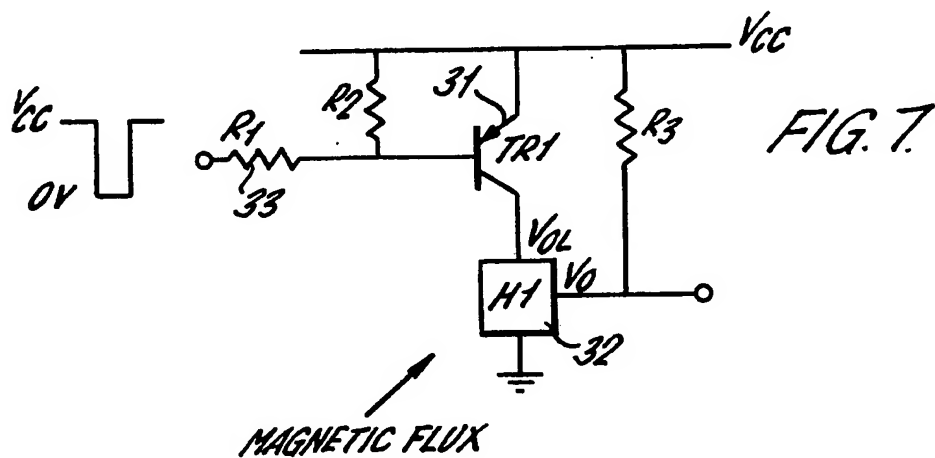
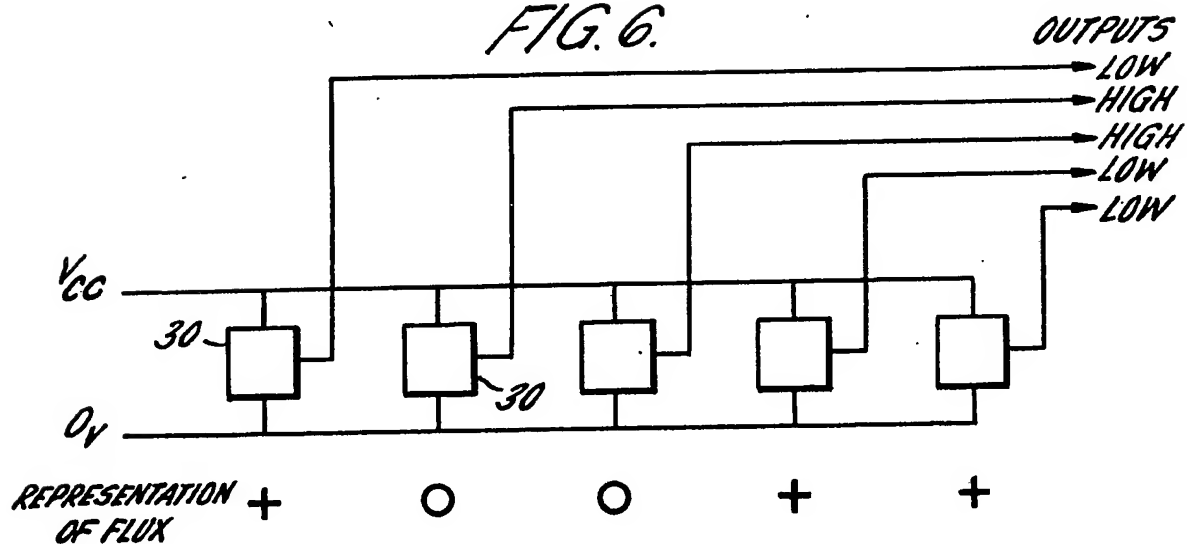


FIG. 6.



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FIG. 8.

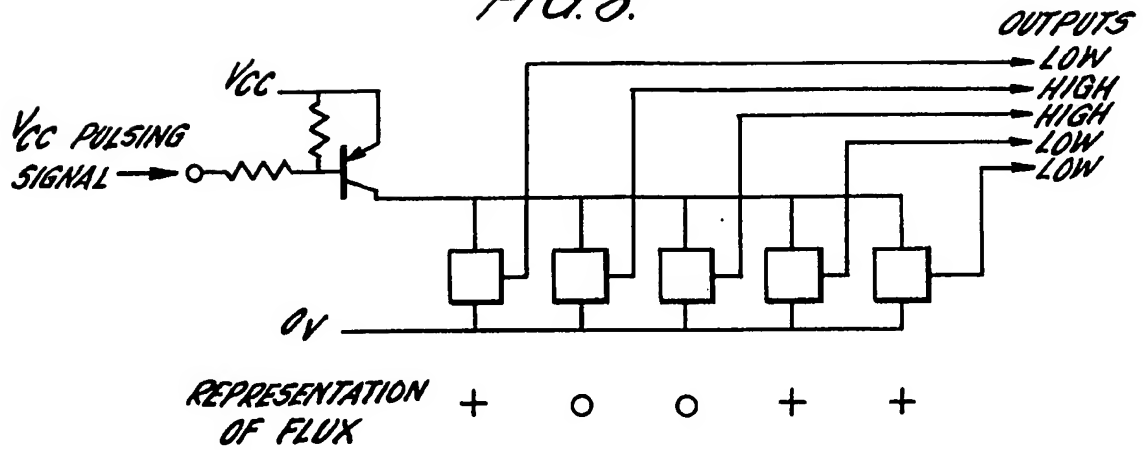
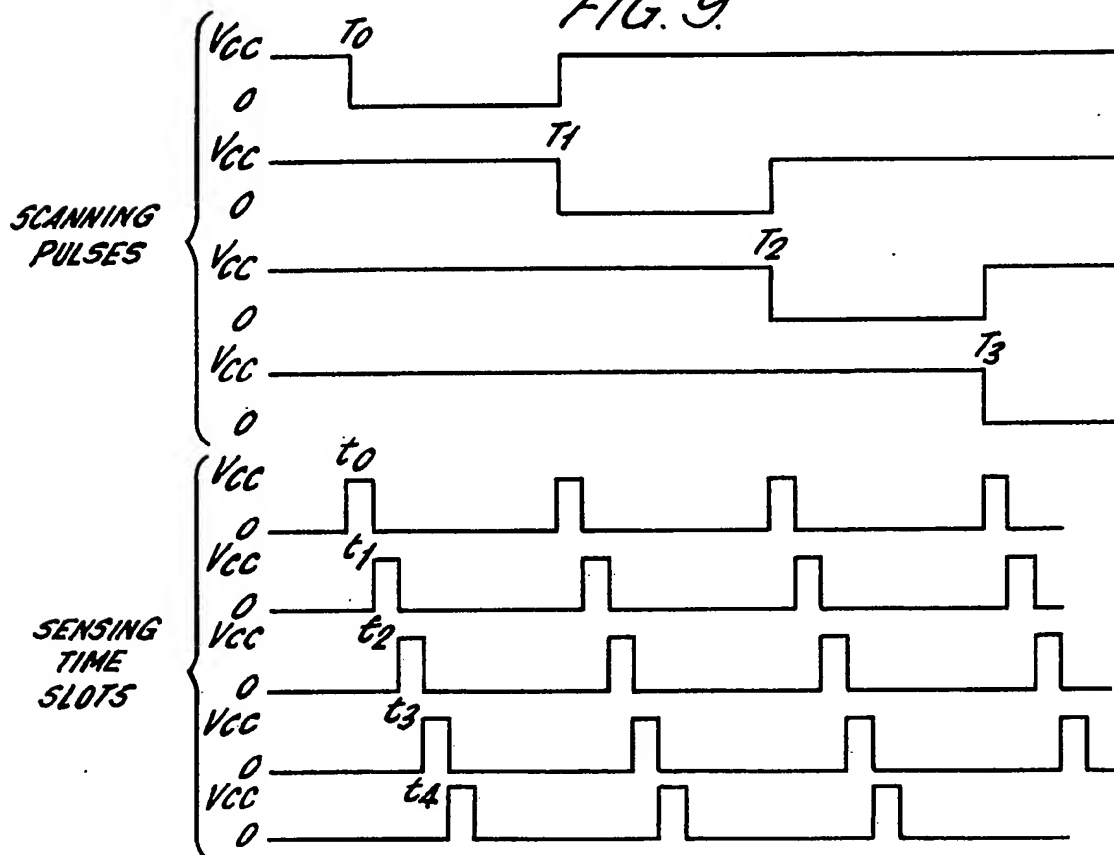
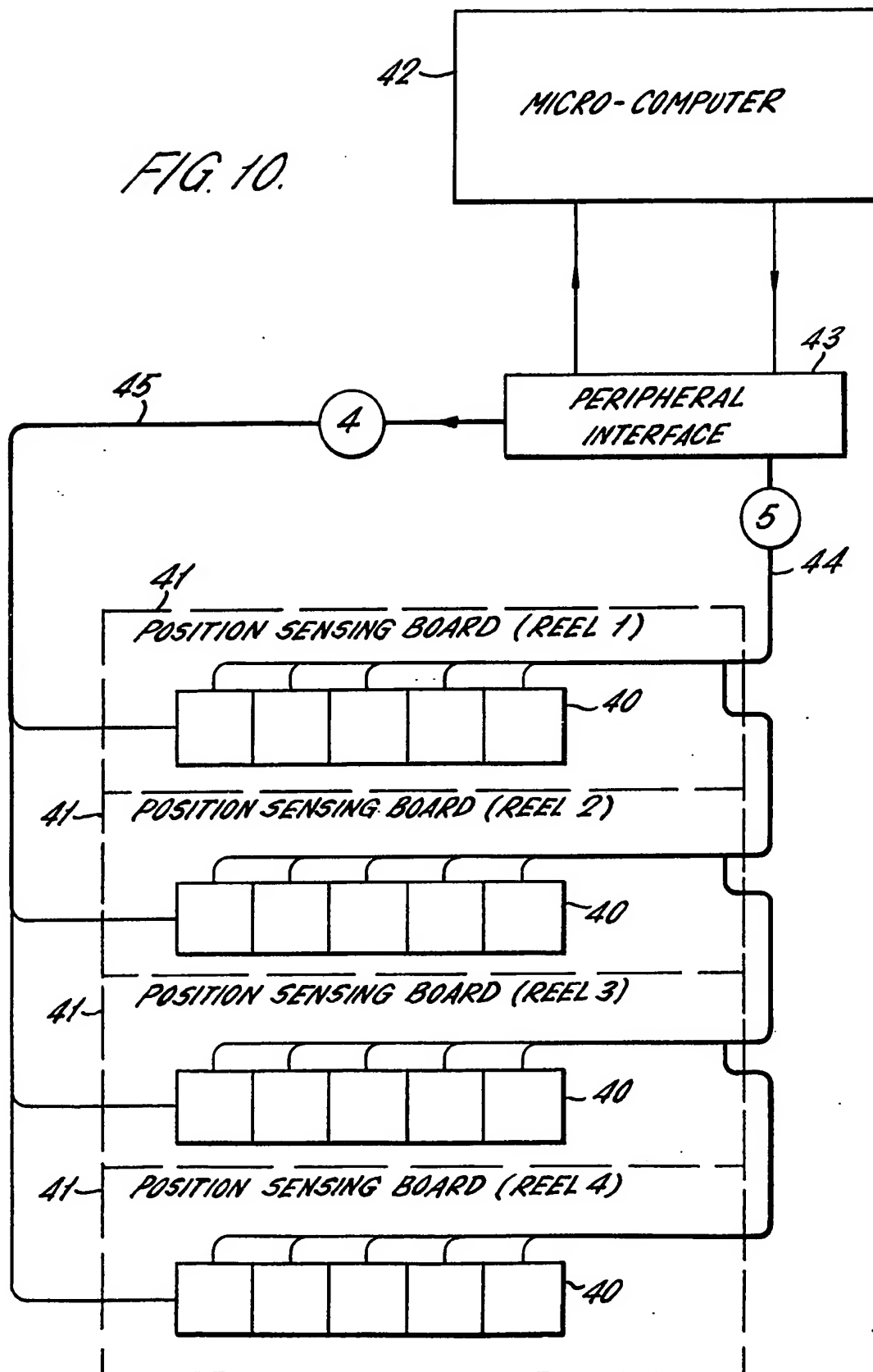


FIG. 9.



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FIG. 10.



# **SPECIFICATION** **Apparatus for Detecting the Angular** **Positioning of a Fruit Machine Reel**

5 The present invention is concerned with  
position detecting apparatus particularly for  
detecting the angular position of a fruit machine  
reel.

Amusement or gaming machines of the type  
known as fruit machines or slot machines are  
10 well-known and typically have at least one and  
usually three or four rotatable reels which are set  
in motion at the beginning of each playing cycle  
of the machine. The reels are marked around their  
peripheries with a number of indicia and they are  
15 arranged to stop rotating after random intervals  
so that a random selection of the indicia are  
visible behind a window of the machine. The stop  
positions of the reels, as indicated by the visible  
indicia, may represent a winning combination in  
20 which case the machine operates automatically to  
pay out the win or notify the player of the win, or  
in some cases to permit the player to select one  
or more further functions or operations of the  
machine. Any gaming or amusement machine of  
25 this general kind with rotatable reels whose stop  
positions determine winning combinations will be  
described hereinafter as a fruit machine.

In such machines it can be seen that it is  
important to be able to detect the stop positions  
30 of the various reels of the machine so that the  
machine can determine whether the indicia  
appearing behind the window of the machine  
represent a winning combination. Various  
methods of detecting the stop positions of the  
35 reels of fruit machines have been proposed and  
operated. For example, it is known to employ  
photoelectric detectors. In such arrangements it is  
usual to provide a plurality of detectors and one or  
more light sources which are fixed in the machine.  
40 A disc is provided rotatable with the reel with the  
disc being coded with holes arranged to align  
with the photo detectors so that a unique  
combination of detectors is exposed to light from  
the light source or sources at each of the stop  
45 positions of the reel which are at equal angular  
spacings.

A summary of various techniques for detecting  
the stop positions of rotatable reels in fruit  
machines is given in the specification of British  
50 Patent 1268104. Various magnetic techniques  
are also mentioned in this specification including  
the use of magnets and reed switches with the  
magnets located on the rotating reel in a coded  
pattern. The specification also suggests detecting  
55 variations in the induction of a circuit and the use  
of Hall-effect devices. However, no detailed  
arrangements are disclosed. The use of magnetic  
techniques is also disclosed in the specification of  
British Patent 1550744, again with the magnets  
60 mounted to rotate with the reel of the machine.

Magnetic angular position sensing techniques  
are known in other fields. The specifications of  
British Patents 1007151 and 1309066 disclose a  
drum display system and a decimal to binary

65 encoder respectively, incorporating magnetic  
angular position detecting. In each of these  
disclosed arrangements fixed magnet and reed  
switch pairs are provided with a coding disc  
rotating between them to selectively shunt the  
70 magnetic fields of the magnets. However, the  
arrangements disclosed are relatively crude and  
do not make efficient use of the magnets.

In accordance with the present invention, there  
is provided apparatus for detecting the angular  
75 position of a fruit machine reel which is rotatable  
in a frame, comprising a plurality of magnetic  
field responsive sensing devices fixed relative to  
in a frame, comprising a plurality of magnetic  
fixed relative to the frame at locations spaced  
80 from respective said magnetic field responsive  
sensing devices whereby each sensing device can  
respond to the magnetic field from a respective  
one of the magnets, and position coding means  
rotatable with said reel and arranged to pass, on  
85 rotation of the reel, between the sensing devices  
and their respective magnets, the position coding  
means having specially varying magnetic  
permeability in the direction of movement relative  
to the sensing devices and magnets whereby the  
90 sensing devices are responsive to the resultant  
variations in the magnetic fields from their  
respective magnets to provide an indication of the  
position of the reel; wherein each of said plurality  
of magnets has its poles aligned in the direction of  
95 the spacing between the magnet and its  
respective sensing device and there is provided  
magnetic shunt means arranged to provide paths  
of relatively high magnetic permeability between  
the sensing devices and the magnet poles remote  
100 from the respective sensing devices so as to  
enhance the magnetic flux across the spacings  
between the respective magnets and sensing  
devices. With this arrangement, relatively small  
size magnets can be used since the shunt means  
105 together with the transverse orientation of the  
magnets enhances the useful flux of the magnets  
of the sensing devices. Also the variation in the  
flux caused by the coding means, and hence the  
responses of the sensing devices can be made  
110 more precise.

Conveniently, the position coding means has a  
first magnetic permeability with code elements of  
a second magnetic permeability distributed  
therein so that each element passes between at  
115 least one of the sensing device and magnet pairs  
on rotation of the reel. Conveniently, the sensing  
devices are each responsive to provide a first  
output indication in the absence of a said code  
element between the device and the associated  
120 magnet and a second output indication in  
response to the presence of a said code element  
therebetween, the code elements being  
distributed in the coding means so that a unique  
combination of the sensing devices provides said  
125 second indication for each of a predetermined  
number of rotary positions of the reel.

Preferably, said sensing devices are Hall-effect  
devices. With Hall-effect devices, power supply  
means are necessary for energising the devices

and the power supply means may include gating means arranged to remove the energising voltage from the devices before their output indications are to be read to determine the relative position of the member, and reapplying the energising voltage when the output indications are to be read. This gating arrangement overcomes the problem arising from the inherent hysteresis of the switching effect of typical Hall-effect devices.

10 In some devices it might be necessary actually to reverse the magnetic field in order to ensure the device switches back to its high level state. However, in the absence of an energising voltage, the device automatically reverts to the high

15 output state so that on reapplying the energising voltage the Hall device will immediately adopt a state dependent on whether the magnetic field at the moment of application of the voltage is above or below the threshold level at which the device normally switches from high output to low output.

Conveniently, the sensing device and magnet pairs are on opposite sides of the radial plane, and the coding means is formed as a disc extending in the radial plane.

25 Then, preferably, the magnetic shunt means comprises at least one U-shaped element of ferro-magnetic material with the arms of the element extending on opposite sides of the coding disc radially inwards from the periphery of the disc so as to interlink said remote magnet poles and the sensing devices.

The magnets may all be mounted on an inner face of a first arm of a common said U-shaped element. Further, the sensing devices may all be

35 mounted at an inner face of the second arm of the element.

In one embodiment, the coding disc is of a material of relatively high magnetic permeability and the code elements are apertures through the disc. Then preferably, the magnetic shunt means is arranged to provide a path of relatively high magnetic permeability between the magnets and the coding disc to shunt the magnetic field of any of the magnets in the absence of an aperture

45 between the respective magnet and its associated sensing device, whereby the sensing device is responsive to a relatively increased magnetic field to indicate the presence of a code element. Alternatively, said second magnetic permeability of the code elements may be greater than said first magnetic permeability, whereby the presence of a said code element between any of the sensing device and magnet pairs enhances the magnetic field at the sensing device. The code

50 elements may be ferro-magnetic.

In one arrangement, the sensing device and magnet pairs are radially spaced apart one pair from another, and the position coding means has a respective track, including at least one of said

60 code elements, for each said pair.

Instead, the sensing device and magnet pairs may be circumferentially spaced one pair behind another at a common radius and each code element may then pass between each of said

65 pairs successively on rotation of said reel.

The present invention further envisages a fruit machine which includes apparatus as described above for detecting the angular position of a reel of the machine.

70 Examples of the present invention will now be described in greater detail with reference to the accompanying drawings in which:

Figure 1 is a view along the axis of rotation of part of a reel assembly from a fruit machine, including reel angular position sensing apparatus embodying the present invention;

Figure 2 is a sectional view along line X—X of Figure 1 illustrating one embodiment of the invention;

80 Figure 3 is a view corresponding to Figure 2 but illustrating a different embodiment of the invention;

Figures 4 and 5 illustrate graphically the range of response characteristics of Hall-effect devices which can be used in the apparatus illustrated in Figures 2 or 3.

Figure 6 illustrates a simple method of energising Hall-effect devices in the apparatus of Figures 1, 2 or 3 using devices having

90 characteristics as illustrated in Figure 4;

Figure 7 is a diagram of a circuit for energising Hall-effect devices enabling devices having a full range of characteristics to be employed;

Figure 8 illustrates a circuit for energising

95 simultaneously all the Hall-effect devices used in the position sensing apparatus of Figure 2 or 3;

Figure 9 is a timing diagram illustrating the sequential scanning of the position sensing devices of each of four reels in a gaming machine

100 and

Figure 10 is a simplified block diagram illustrating the connection of the position sensing apparatus illustrated in Figure 1 into a microcomputer system for controlling the

105 operation of the gaming machine.

Referring to Figure 1, there is illustrated a reel 10 which is mounted for rotation about an axis 11. The reel 10 forms part of a fruit machine as hereinbefore defined and in a typical complete machine there may be three or four such reels which are commonly arranged on a common axis. In operation of the machine, the reels are set in motion, rotating in the direction of arrows 12, when a player initiates a play cycle of the machine. After predetermined lengths of time, the reels are stopped, usually one reel after the other. The reels normally have a predetermined number of indicia, e.g. pictures of fruit or other devices, arranged equally spaced about the outer

120 periphery 13 of the reel, and the reels are normally indexed so as to be stopped at a randomly selected one of the stop positions corresponding to one of the indicia being aligned behind a viewing window of the gaming machine.

125 As explained previously, it is important for operation of the gaming machine to determine the positions at which the various reels of the machine have stopped and for this purpose apparatus is provided for sensing the stop

130 positions of the various reels. In Figure 1, the

apparatus for one of the reels is illustrated and comprises a coded disc 14 mounted for rotation with the reel 10 about the axis 11. Mounted fixed adjacent the disc 14 is a printed circuit board 15 on which are mounted, inter alia, five Hall-effect devices 16 to 20.

The Hall-effect devices 16 to 20 are mounted on the circuit board 15 so as to be radially aligned relative to the axis 11. Printed circuit board 15 with the Hall-effect devices is fixed to the chassis of the assembly containing the rotatable reel 10. The coded disc 14 contains a plurality of code elements 21 arranged in five concentric annular tracks 22 to 26. The radial spacing of the tracks 22 to 26 is the same as the spacing between adjacent Hall-effect devices 16 to 20 and the Hall-effect devices are located on the printed circuit board 15 to one side, behind in Figure 1, the disc 14 so that, as seen in Figure 1, the elements 21 of each track pass immediately in front (in Figure 1) of a respective one of the Hall-effect devices.

Figure 2 is a cross-sectional view taken along line X—X of Figure 1. A horseshoe or U-shaped bracket of a ferro-magnetic material is fixed to the printed circuit board by one arm 28 which is provided with apertures for the Hall-effect devices 16 to 20. The other arm 29 of the bracket 27 extends radially on the opposite side of the disc 14 from the Hall-effect devices. Magnets 50 to 54 are mounted on an inner face of the arm 29 of the bracket 27 between the bracket and the disc 24. The magnets 50 to 54 are aligned with respective Hall-effect devices on the opposite side of the disc 14 so that each Hall-effect device is predominantly in the influence of the magnetic field from a respective one of the magnets. Each of the magnets 50 to 54 is mounted with its poles aligned in the direction of the spacing between the magnet and its associated Hall-effect device, i.e. transversely of the coded disc 14. Normally, the magnets are arranged with corresponding poles adjacent the arm 29 of the bracket 27 and opposite poles nearest the respective Hall-effect devices.

The bracket 27 provides a magnetic shunt between the magnet poles remote from the Hall-effect devices to positions behind the Hall-effect devices and thereby enhances the magnetic field from each magnet which traverses its associated device.

In the example of Figure 2, the coded disc 14 is formed in a dielectric material having a low relative permeability. The code elements 21 are then formed as inserts 55 in the disc 14 of a material having a high relative permeability, typically of a ferro-magnetic material.

It will be appreciated that the presence of a ferro-magnetic insert 55 immediately between an adjacent pair of Hall-effect devices and magnets has the effect of enhancing further the magnetic field strength at the Hall-effect device. The spacing between the Hall-effect devices and the magnets must, of course, be sufficient to accommodate the width of the disc 14 with insert

55. However, this spacing, the size of the inserts 55 and also the field strength of the magnets is carefully selected to ensure that the Hall-effect device will adopt its high field (low voltage output) state only when there is an insert 55 immediately between the device and its respective magnet. In the absence of an insert, the field strength at the Hall-effect device is too low to switch the device.

It will be appreciated that for a fruit machine, there are a predetermined number of equally spaced possible angular stopping positions corresponding to the number of indicia marked about the periphery 13 of the reel 10. The code elements 21 are arranged on the coded disc 14 so that at each of the predetermined stopping positions, a predetermined unique combination of elements, from respective tracks 22 to 26, are located between respective magnets and Hall device pairs. It is important to ensure that a Hall device adopts its high field state only when there is an insert 55 correctly located between the device and its associated magnet. Clearly, the angular selectivity of the switching of the Hall-effect devices must be less than the angular spacing between adjacent stop positions of the reel, so as to ensure unambiguous reading of the actual stop positions. Furthermore, it is important to ensure that the inserts 55 in one track do not cause switching of a Hall device associated with a different track.

In the example of Figure 2, the horseshoe bracket 27 provides a return path shunt for the magnetic field of the magnets 50 to 54.

Figure 3 shows a different arrangement but parts of the apparatus in Figure 3 which are the same as those in Figure 2 are given the same references. In Figure 3 the coded disc 14 is itself formed of a ferro-magnetic material. In this arrangement, the code elements 21 are formed as apertures 56 through the disc 14. Then, in the absence of an aperture 56 correctly located between a Hall-effect device and its associated magnet, the magnetic field from the magnet is shunted and diffused in the coded disc 14. On the other hand, the diffusing effect of the disc 14 is much less in the presence of an aperture 56. Again, the arrangement is made such that each Hall-effect device adopts its high field state only when there is an aperture 56 correctly positioned between the device and its associated magnet.

The spacing between the outer peripheral edge 57 of the disc 14 and the adjacent part of the horseshoe bracket 27 may conveniently be kept relatively small to improve the magnetic shunting effect of the disc 14.

Figures 4 and 5 illustrate graphically the variation in the switching characteristics of Hall-effect devices. Hall-effect devices have three terminals and a predetermined energising voltage is applied across two of the terminals. The third, output, terminal then adopts a voltage dependent on the magnetic flux density to which the devices is exposed. The output voltage on the third terminal is normally high until the flux density reaches a threshold level at which the output

voltage switches suddenly to a relatively low level. However, there is considerable hysteresis in the operation of the device so that the device only switches back again to the high output level

5 when the flux density is reduced to a second threshold level considerably below the first threshold level. Thus, the operation of a typical device as illustrated in Figure 4 with the arrows indicating the direction of switching between the high output voltage level  $V_{OH}$  and the low output voltage level  $V_{OL}$ . Variation between devices produced even on the same production run can cause the switching threshold, for the device to return to the high output voltage state, to be shifted to the left of the y-axis, as shown in Figure 5, and corresponding to the need to reverse the direction of magnetic flux in order to switch the device back to the high output voltage state. Clearly, a device having the characteristic of Figure 5 could not be made to work if constantly energised in the position sensing apparatus of the present invention using fixed magnets since it would not be possible to reverse the flux. However, selected devices all having characteristics as illustrated in Figure 4 could be used in a simple circuit as shown in Figure 6 in which all five of the Hall-effect devices 30 are connected in parallel between a supply rail at an energising voltage  $V_{CC}$  and a 0 volts rail. If some of the devices 30 are exposed to flux above the upper threshold level (the right-hand vertical line in Figure 4) as illustrated in Figure 6 by the sign "+" and others of the devices are exposed to substantially no flux or flux which is less than the lower threshold voltage (the left-hand vertical line in Figure 4) as illustrated by the sign "0" in Figure 5 then the outputs of the devices will be low or high as shown in the figure. These output levels can be read in the usual way to generate a binary number representative of the stop position of the reel.

Figure 7 illustrates a simple circuit which enables Hall devices having characteristics ranging from those illustrated in Figure 4 to those of Figure 5 to be used in the described apparatus. In the circuit of Figure 7, a gating transistor 31 has its emitter collector circuit connected in series with the Hall-effect device 32 so as to control the application of energising voltage to the device. A control pulse can then be supplied to the base of transistor 31 via a resistor 33 to switch off the transistor 31, de-energising the Hall device 32. It is a characteristic of Hall-effect devices that they automatically adopt the high output voltage state when first energised unless the magnetic flux is above the upper threshold level. Therefore, if the Hall-effect device 32 is de-energised until it is desired to determine the position of the reel, on energising the device when the reel position is to be measured the Hall device immediately adopts the state corresponding to the magnetic flux density at that time. Thus, as shown in Figure 7, a negative-going pulse is applied to the base of transistor 31 to switch the transistor on whenever it is desired to read the position of the reels. The

output from the Hall-effect device 32 adopts a state dependent on the magnetic flux level at the moment when it is first energised.

A practical circuit for controlling the energising of all five Hall devices simultaneously is shown in Figure 8.

The position sensing apparatus described can be used in a gaming machine of the fruit machine type which has a microcomputer system programmed and arranged to control the operations of the machine. Thus, as illustrated in Figure 10, a complete gaming machine may have four reels with each reel having its own position sensing apparatus comprising a group 40 of five Hall-effect devices with associated coded discs having magnetic inserts. Each of the groups 40 of the devices are mounted on a respective printed circuit board 41 corresponding to the board 15 of Figure 1. The output indications from the Hall-effect devices on the various board are fed into a microcomputer 42 under the control of a peripheral interface unit 43. The microcomputer 42 typically includes a microprocessor and random access memory as well as read-only memory containing its instruction programme and data. In order to reduce the number of signal lines required connecting the circuit boards 41 with the peripheral interface unit 43, the peripheral interface controls the circuitry on the boards 41 so that each of the boards is scanned in turn and presents data representing the output indications of its five Hall-effect devices sequentially on a common five-bit bus 44 connected to all four boards 41. The boards 41 are controlled by scanning pulses supplied by the peripheral interface unit 43 on a four-bit control bus 45. Figure 9 illustrates the timing sequence of the scanning pulses on the bus 45. One of the lines of the bus 45 is fed to a respective one of the four boards 41 and the scanning pulses sequentially energise the boards 41 so that for example the board for reel 1 is energised during the pulse starting  $T_0$ , the board for reel 2 is energised during the pulse of  $T_1$  and so forth.

Conveniently, the scanning pulses are used in the boards 41 to gate the transistor supplying energising voltage to the Hall-effect devices so that the five devices on any one board are all energised simultaneously so that signals representing their output indications are supplied on the data bus 44 and can be read in the peripheral interface 43 for onward transmission to the microcomputer 42. Typically, the peripheral interface unit 43 itself communicates with the microcomputer by sending the five-bit words received from the boards 41 as serial information along a single data line. The timing pulses for serialising the five-bit words are illustrated in the bottom half of Figure 9.

In a preferred embodiment of microprocessor controlled machine, the instantaneous angular positions of the reels are substantially continuously monitored by the microprocessor by interrogating the Hall-effect devices repeatedly at a relatively high rate.

For example, each bank of Hall-effect devices may be interrogated every 10 mS. At typical rotation speeds of the reels, this provides at least two interrogations of each equivalent stop position as the reels are rotating. This technique enables the microprocessor to check that the reels are rotating when they are supposed to be in accordance with processor control. This has special advantages in preventing certain sorts of improper or illegal interference with normal operation of the machine.

A preferred type of Hall-effect device for use in the described example is the device TL 170 C available from Texas Instruments.

A preferred magnetic insert is a ferrite magnet having pole faces 7.7 mm square and 6 mm in length. The above Hall-effect devices have a maximum upper switching threshold of 25 milliTesla. Reed switches may be employed as magnetic field sensitive devices in an alternative embodiment of the machine.

The above described examples of the present invention illustrated in Figures 1, 2 and 3 of the drawings employs Hall-effect devices which are spaced apart transversely of the direction of movement of the coded disc 14, i.e. spaced along a radius of the axis of rotation. However, it is also possible to employ the present invention using the Hall-effect device and magnet pairs positioned at the same radius and spaced apart circumferentially. Then, a single track of code elements is provided on the disc 14 at the radius of the sensing devices and each element passes between each sensing device and magnet pair in turn as the reel rotates. It is possible to position the code elements about the circumference of the disc 14 so that a unique combination of elements aligns between sensing device and magnet pairs at each of the stopping positions of the reel.

The magnets disclosed in the present specification are preferably permanent magnets but electromagnets may alternatively be employed. Such electromagnets may be selectively energised one after another when making a position reading to avoid the possibility of the field from one magnet influencing the sensing device of a different magnet and device pair.

## 50 Claims

1. Apparatus for detecting the angular position of a fruit machine reel which is rotatable in a frame, comprising a plurality of magnetic field responsive sensing devices fixed relative to the frame, a corresponding plurality of magnets fixed relative to the frame at locations spaced from respective said magnetic field responsive sensing device whereby each sensing device can respond to the magnetic field from a respective one of the magnets, and position coding means rotatable with said reel and arranged to pass on rotation of the reel between the sensing devices and their respective magnets, the position coding means having spatially varying magnetic permeability in

65 the direction of movement relative to the sensing devices and magnets whereby the sensing devices are responsive to the resultant variations in the magnetic fields from their respective magnets to provide an indication of the position of the reel, wherein each of said plurality of magnets has its poles aligned in the direction of the spacing between the magnet and its respective sensing device and there is provided magnetic shunt means arranged to provide paths of relatively high magnetic permeability between the sensing devices and the magnet poles remote from the respective sensing devices so as to enhance the magnetic flux across the spacings between the respective magnets and sensing devices.

2. Apparatus as claimed in Claim 1 wherein the position coding means has a first magnetic permeability with code elements of a second magnetic permeability distributed therein so that each element passes between at least one of the sensing device and magnet pairs on rotation of the reel.

3. Apparatus as claimed in Claim 2 wherein the sensing devices are each responsive to provide a first output indication in the absence of a said code element between the device and the associated magnet and a second output indication in response to the presence of a said code element therebetween, the code elements being distributed in the coding means so that a unique combination of the sensing devices provide said second indication for each of a predetermined number of rotary positions of the reel.

4. Apparatus as claimed in Claim 3 wherein said sensing devices are Hall-effect devices.

5. Apparatus as claimed in Claim 4 wherein power supply means are provided for energising the Hall-effect devices, the power supply means including gating means arranged to remove the energising voltage from the devices before their output indications are to be read to determine the relative position of the member, and re-applying the energising voltage when the output indications are to be read.

6. Apparatus as claimed in any of Claims 3 to 5 wherein the sensing devices and magnet pairs are on opposite sides of a radial plane, and the coding means is formed as a disc extending in the radial plane.

7. Apparatus as claimed in Claim 6 wherein the magnetic shunt means comprises at least one U-shaped element of ferro-magnetic material with the arms of the element extending on opposite sides of the coding disc radially inwards from the periphery of the disc so as to interlink said remote magnet poles and the sensing devices.

8. Apparatus as claimed in Claim 7 wherein the magnets are all mounted on an inner face of a first arm of a common said U-shaped element.

9. Apparatus as claimed in Claim 8 wherein said sensing devices are all mounted at an inner face of the second arm of the element.

10. Apparatus as claimed in any of Claims 6 to

9 wherein the coding disc is of a material of relatively high magnetic permeability and the code elements are apertures through the disc.

11. Apparatus as claimed in Claim 10 wherein  
5 the magnetic shunt means is arranged to provide a path of relatively high magnetic permeability between the magnets and the coding disc to shunt the magnetic field of any of the magnets in the absence of an aperture between the  
10 respective magnet and its associated sensing device, whereby the sensing device is responsive to a relatively increased magnetic field to indicate the presence of a code element.

12. Apparatus as claimed in any of Claims 3 to  
15 9 wherein said second magnetic permeability of the code elements is greater than said first magnetic permeability, whereby the presence of a said code element between any of the sensing device and magnet pairs enhances the magnetic  
20 field at the sensing device.

13. Apparatus as claimed in Claim 12 wherein the code elements are ferro-magnetic.

14. Apparatus as claimed in any of Claims 2 to  
25 13 wherein the sensing device and magnet pairs are radially spaced apart one pair from another, and the position coding means has a respective track, including at least one of said code elements, for each said pair.

15. Apparatus as claimed in any of Claims 2 to  
30 13 wherein the sensing device and magnet pairs are circumferentially spaced one pair behind another at a common radius and each code element can pass between each of said pairs successively on rotation of said reel.

35 16. Apparatus for detecting the angular position of a fruit machine reel, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

17. A fruit machine including apparatus as  
40 claimed in any preceding claim.

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